Economic Impacts

of

The Petition for Proposed Amendments Pertaining to Nondegradation Requirements for Electrical Conductivity and Sodium Adsorption Ratio and Definitions for Technology-Based Effluent Limitations and the Adoption of New Water Quality Rules I through X Pertaining to Minimum Technology-Based Controls and Treatment Requirements for the Coal Bed Methane Industry.

Prepared by
Montana Department of Environmental Quality
December 2005

The Economic Impacts of the Petition

Background

The Petitioners have asked the Board of Environmental Review to adopt a rule limiting the discharge of pollutants to waters of the United States from the methane industry. This would be done under the proposed rule by establishing minimum technology-based control and treatment requirements for the industry. Acceptable technologies for water disposal under the petition include injection, re-injection, and advanced water treatment before surface discharge (e.g. reverse osmosis, ion exchange).

Because it is impossible to know exactly what will happen in the future with coalbed methane (CBM) development in Montana, this analysis is driven by assumptions. The assumptions are based upon the best available information from a variety of sources including several CBM economic studies from private and government sources. The assumptions are also based on talks with industry, talks with geologists and hydrologists, gas well data, the 'Montana Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans'[1] (EIS), and best professional judgment. The assumptions are used to estimate the most likely scenario for Montana CBM development in the future under current law and the most likely scenario(s) if the petition were in effect. The difference between the current law scenario and the proposed rule scenario(s) is the economic impact of the proposed rule under the petition.

The assumptions are given first, and the economic impact analysis follows. Within the analysis, a baseline scenario is given that estimates future CBM development in Montana under current law. Scenarios are then presented on what CBM development would look like under the petition. Estimated costs and benefits of the petition compared to the baseline are discussed in both qualitative and quantitative terms. Where possible, values are quantified. A sensitivity analysis is provided for costs based on a reasonable range of values of the most important assumptions. This range represents a reasonable upper and lower bound for estimated costs from the petition. Benefits of the petition are discussed in qualitative terms only, and therefore no numerical sensitivity analysis is performed.

Assumptions Used in this Analysis

The assumptions upon which this analysis is based are presented in this section. These assumptions and how they were derived are discussed in detail at the end of the paper in Appendix A: Detailed Discussion of Assumptions Used in this Analysis.

- **Total CBM Wells Developed in Montana and Ownership of Mineral Rights:** 12,500 CBM wells will be located in Montana with about 90% of these wells located in three counties: Big Horn, Rosebud, and Powder River. 5,788 of these wells

[1] BLM, Miles City and Billings Field Offices, Montana DEQ, Montana Board of Oil and Gas Conservation, January 2003.

(46.3%) will be located on land where the federal government, specifically the Bureau of Land Management, owns the mineral rights, 6,088 wells (48.7%) will be located on land with privately owned mineral rights, and 625 wells (5%) will be located on land with state-controlled mineral rights (EIS: BLM et.al.).

- **Average Natural Gas Production per Well:** The average working CBM well in Montana will produce 0.18-0.30 billion cubic feet (Bcf) of gas over its working life or 180,000-300,000 thousand cubic feet (Mcf) per well. The average well will produce for 15 to 20 years (EIS: BLM et. al.; MBOGC).

- **Time Scale of Development:** CBM development in the Montana Powder River Basin (PRB) will take place over the next 20-40 years with an average estimate of 30 years (and an average single well lifetime of 20 years).

- **Water to Gas Ratio:** In the PRB, between 2.0 and 2.75 barrels of CBM-discharged water are produced on average for every Mcf of gas produced (U.S. Dept of Interior, Horsley and Witten Inc., MBOGC).

- **Future average wellhead price of natural gas in the United States:** The average wellhead price of natural gas in the U.S. as a whole will average between $4.55/Mcf and $6.31/Mcf in 2005 dollars over the next 20 years from 2006-2025 (EIA, Jan. 2005, Nov. 2005 and Dec. 2005).

- **Future average annual wellhead price of natural gas in the PRB:** The average wellhead price of natural gas in the PRB will average anywhere from $3.30/Mcf to $5.80/Mcf (in 2005 dollars) over the next 20 years with a mid-point price of $4.50/Mcf. This estimated range is calculated by estimating a basin wellhead price differential between the PRB and the Henry Hub of $0.80 to $1.60 per Mcf and a difference between the Henry Hub and U.S. average wellhead price of $0.30/Mcf (EIA 2003, DOE, Associated Press, Enerfax Daily)**.**

- **Capital and operating costs to CBM operators using surface water disposal (the cheapest water disposal method) will average no more than $2.60/Mcf.** The capital and O& M costs per well in the PRB (excluding water disposal) will be no more than $1.60/Mcf on average in 2005 dollars. With royalties and taxes added on (assuming a $4.50/Mcf gas wellhead price in the PRB), costs per Mcf are $2.60/Mcf (DOE, Goerold, Kuipers)

- **CBM water treatment under current law:** Under current law, without the proposed rule, CBM operators would use advanced treatment (such as reverse osmosis) on 20% of discharged water. The other 80% would be disposed of in the least costly way possible to meet existing water quality standards, such as into percolating ponds or directly into state waters.

- **CBM water treatment under the proposed rule in the petition:** Under the conditions laid out by the petition, 20% of CBM-produced water from wells in

Montana would be injected or re-injected into the ground as a water disposal technique. Geological and technical constraints would prevent any more than 20% of water from being injected (BLM et. al.). Because the only other acceptable disposal techniques under the petition would involve advanced water treatment (e.g. reverse osmosis, ion exchange), the remaining 80% of water disposed under the petition would use advanced water treatment before being discharged above ground.

- **Cost of injection:** Using the upper range of available studies, it would cost CBM operators $0.80/Mcf more on average to use injection/reinjection of methane-produced water than to use the cheapest method of surface disposal into nearby waterways (Goerold, Kuipers, Bowen, Wo et. al., DOE).

- **Cost of advanced water treatment:** Using the upper range of available studies, it would cost CBM operators $0.40/Mcf more on average to use advanced water treatment (e.g. reverse osmosis, ion exchange) to treat water than it would cost to use surface disposal. For simplicity, it is assumed that all water treatment technologies would average $0.40/Mcf in cost (Kuipers, Bowen).

- **Average additional cost of water management under the petition as compared to current law:** The average cost for a CBM operator under the petition would be $0.40/Mcf greater than it would be using surface water disposal. This is arrived at by summing $0.80 of additional cost for injection multiplied by 20% (16 cents/Mcf) and $0.40 additional cost for advanced treatment multiplied by 80% (32 cents/Mcf). Summing these two numbers results in a $0.48/Mcf average water management cost for operators under the petition. Under current law and assuming a zero cost for direct surface water discharge, the average water management cost for a CBM operator would be about $0.08/Mcf, which is arrived at by multiplying $0.40/Mcf for advanced treatment times 20% (8 cents/Mcf). The difference between these two costs is $0.40/Mcf. For sensitivity analysis purposes, this additional cost number could range from $0.20 to $0.60 per Mcf.

- **A Power River Basin wellhead gas price of $3.50/Mcf is the operator breakeven point for the average well for all water disposal methods.** Therefore, the number of wells drilled in the Montana portion of the PRB would be the same under the petition as it would be without the petition, except under the most adverse conditions to industry (such as $3.30/Mcf gas and low well production). Under the most adverse conditions to industry, the petition would result in up to 20% fewer wells.

- **Coalbed methane is natural gas and is taxed as natural gas.**

- **Natural gas production tax:** Under MCA 15-36-304, the natural gas production tax is 9.26% on gross revenues. Most of that tax, the 9.00% portion, goes to the state general fund, two special revenue accounts and the counties within which development takes place. A 0.18% portion goes to the privilege and license tax which is a state special revenue fund for the purpose of paying expenses of the Montana Board of Oil and Gas Conservation. The remaining 0.08% goes to the oil, gas, and

coal natural resource account. In the first year of a CBM well, the gas production tax is only 0.76%, but for simplicity's sake, and due to the fact that first year gas production of a typical CBM well is negligible, a 9.26% rate is assumed for the lifetime of the well.

- **Royalties:** The royalty rate for the mineral right holder is 12.5%, which is the standard royalty rate. Other royalty rates exist, but for simplicity the 12.5% rate is assumed for all wells. The tax on royalties held by private landowners is 15.06%. Royalties that go to federal and state mineral right owners are not taxed (Montana Dept. of Revenue, personal communication)**.**

- **Tax distribution:** Under MCA 15-36-331, Big Horn County shall receive 45.05% of total natural gas production taxes collected from wells located in within its borders, Powder River County 60.9%, and Rosebud County 39.33%. Weighting these averages by the estimated number of wells in each county, about 50% of total natural gas production taxes collected in this tri-county area would go to the counties. Under MCA 15-36-332, of the total money that goes to counties, Big Horn will put 26.99% towards school districts, Powder River 22.25% and Rosebud 72.97%. Under MCA 15-36-331, the rest of the natural gas production tax money, the other 50%, goes mainly to the state general fund with a small portion going to four other accounts (2 of them state special revenue funds).

- **Royalties on state land:** All of royalties earned on land with state mineral rights goes to the permanent school trust fund. Half of the royalties earned on land with federal mineral rights goes to the state of Montana. Under MCA 17-3-240, money paid to the state from federal royalties must be deposited in the state general fund. In fiscal year 2005 and each succeeding fiscal year, 25% of all of this money received by the states is dedicated to local governments.

- **Montana's corporation license tax:** The state corp tax is a franchise tax levied on corporations, including banks and savings and loan associations, for "…the privilege of carrying on business in this state." The tax is levied at the rate of 6.75% on net income (or net revenues) earned in Montana. 100% of corporate license taxes are deposited into the state general fund. (Montana Department of Revenue, 2002-2004 Biennial Report).

- **Business equipment tax collections on CBM equipment would possibly increase by as much as 50% under the petition, but are beyond the scope of this analysis (Kuipers, DOE, Goerold).**

Economic Impact Analysis

All dollars figures given from here on are in 2005 dollars unless otherwise indicated.

Costs of the Petition

Summary

Four scenarios are presented in this cost section. The first is a baseline scenario estimating what CBM production would look like in Montana under current law. The other three scenarios would occur under the proposed rule. These three include a least cost scenario from the petition (best case), a middle cost scenario, and a most costly scenario (worst case). Under all three scenarios, the main cost of the petition would be lower profits to industry. This is far and away the greatest cost in dollar terms of the proposed rule. In the most costly (worst case) scenario, the petition would result in up to 20% fewer wells being drilled in Montana, and costs would increase significantly to include up to 20% fewer jobs, 20% less personal income for workers, 20% less personal income tax collection from methane-related economic activity in Montana, 20% less natural gas extracted, secondary economic costs on area businesses, and up to 40% less tax revenue to the state of Montana and local governments from CBM. The main groups that would experience costs would be in-state and out-of-state companies (both large and small) and the State of Montana. In the most costly scenario with fewer wells, affected groups would also include natural gas workers, natural gas users nationwide, the counties within which development would occur (mainly Big Horn, Powder River and Rosebud), the schools within those counties, related businesses (such as suppliers) and area businesses.

Cost Calculations and Sensitivity Analysis (Varying Key Assumptions)

A baseline scenario estimates CBM economic numbers that would occur in Montana without the petition. The cost analysis then begins by comparing the three cost scenarios that would occur under the petition to the baseline scenario. Mid-point values from the assumptions given in the previous section are initially used for this analysis to arrive at the middle cost estimate. In this middle cost estimate, only Powder River Basin wellhead gas prices are varied. A key assumption under the middle cost and least cost estimate is that the total number of wells drilled and total gas produced would be the same under the petition as it would be in the baseline without the petition due to the relatively high prices that natural gas operators are getting for their product. This assumption is made because the estimated future gas price range in the PRB ($3.30/Mcf to $5.80/Mcf) is mostly above the assumed operator breakeven point for all water disposal techniques of $3.50/Mcf priced gas.

A sensitivity analysis on the initial middle cost result is then performed varying other assumptions including lifetime gas production per well and the average cost of water treatment under the petition. A key assumption that is varied in the sensitivity analysis is the assumption that under the most costly (worst case) conditions to industry, 20% fewer

wells would be drilled under the petition due to economic constraints imposed by the rule. Varying different assumptions results in a range of costs that more accurately reflects possible effects on industry, state and local government from the petition.

Baseline Scenario without the Petition: The estimated total gross revenue from all CBM produced in Montana is estimated to be in the range of $9.9 to $17.4 billion (using the $3.30/Mcf to $5.80/Mcf price range at the PRB wellhead). $13.5 billion is an approximate midpoint number for estimated total gross revenue from methane production in Montana[2]. It is assumed that this revenue will be made over the next 30 years of development in Montana, which would indicate an average CBM gross revenue in Montana of about $450 million per year over 30 years (understanding that CBM gross revenue in Montana will significantly fluctuate from year to year). Estimated profits to the industry over 30 years of development, using the estimated $2.60/Mcf cost to operators, ranges from $2.1 billion ($3.30/Mcf gas) to $9.6 billion ($5.80/Mcf)[3].

The EIS estimates 851 jobs as the annual average from Montana CBM development for 16,500 CBM wells (BLM et. al, p. 4-117, Table 4-49). Lowering that number down proportionately to the 12,500 wells assumed in this impact statement gives an average employment figure of 645 jobs in Montana from CBM production over a 30-year period. The same table estimates total wages over 30 years of CBM development of $599 million. Ratcheting this number down proportionately results in $455 million in total personal income over 30 years for 12,500 wells. Using a 3% average state income tax rate, income taxes collected would be about $13.7 million total over 30 years to the state general fund or about $450,000 per year.

With the Petition: Middle Cost Scenario (assuming no change in the number of wells as a result of the petition): The cost analysis estimates the costs to industry and society of the petition compared to the baseline numbers estimated above. Midpoint assumptions used in this initial analysis include an average Wyoming wellhead price in the Powder River Basin (PRB) over the next 20 years of $4.50/Mcf and an average cost per well of $2.60/Mcf for capital and O&M costs, royalties and taxes. As mentioned earlier, in this middle cost estimate, it is assumed that at $4.50/Mcf, the total number of wells drilled in the Montana PRB would remain at 12,500 with or without the petition in effect. Using the assumption of $0.40/Mcf in additional water disposal costs on average under the proposed rule, the rule would cost the CBM industry an estimated $1.2 billion dollars in profit, which is a decrease in profits of 13% to 57% ($5.80 and $3.30 gas respectively) under the petition. At a price of $4.50/Mcf, industry profits would decrease on average by 21% under the petition. Therefore, industry would bear on average $1.2 billion in extra costs (or reduced profit) over 30 years or 21% lower profits from the petition.

[2] $13.5 billion in gross revenue is calculated based on the following assumptions: 12,500 total wells in Montana multiplied by 240,000 Mcf per well multiplied by $4.50/Mcf average wellhead price in the Powder River Basin.

[3] Two extreme cases (low price, low production and high price/high production) yield profit values of $1.58 billion and $12.0 billion (see Table 1) under the baseline.

Industry would still make $4.50 billion in profits over 30 years from Montana CBM under the petition versus $5.70 billion without the petition.

Corporation license tax collections from the CBM industry would decrease by 21% under the petition, since they are directly based on net revenue or profits. Because corporation tax losses would come out of industry profit losses, it is important to count them as a portion of the profits loss and not as a separate, additional loss because to count them separately would lead to a double counting of costs. It is important to note, however, that this tax loss would be borne by the Montana state general fund and not the companies. The corporation tax collected is 6.75% of net income earned in Montana. Using the $0.40/Mcf additional cost under the petition (or $0.40 less profit per Mcf), and $450 million per year in total gross revenue to the industry ($13.5 billion divided by 30 years) or 100 million Mcf (100 Bcf) of gas produced per year in Montana, profits (net income) would be $40 million less per year to industry. 6.75% of that number, the corp tax rate, is $2.7 million per year less corporate tax to the state general fund or $81 million less money to the state general fund from corporation license tax over 30 years.

Under the assumption of 12,500 wells being drilled with or without the petition, natural gas production taxes would not change since they are based upon gross revenue, which is based upon the total number of wells drilled and total amount of gas produced. Because the natural gas production tax is based upon gross revenues only, a change in cost would not affect the total tax collected, and thus would not affect any of the entities (state general fund, counties, state special revenue funds) that receive that money. The natural gas production tax is far and away the largest money maker for the state and counties from gas production. Jobs, personal income, and personal income taxes from workers in the industry also go to the state and counties, but would not be adversely affected in the middle cost scenario because it is expected that the same number of wells would occur under all water disposal technologies. In fact, jobs, income and personal income taxes could go up by as much as 10% under the petition due to any increased labor needed for injection/reinjection and advanced water treatment activities. This potential benefit is described in more depth in the benefits section below.

TABLE 1: Baseline Profit Levels for the Industry Without the Petition Compared to Profit Levels With the Petition Using the Middle Cost Scenario and Assuming No Change in Number of Wells

REVENUES WITHOUT THE PETITION USING SURFACE DISPOSAL

	Tot wells	Mcf/well	Price	Tot Rev	Profit ($2.60 cost)	Change Profit	% change profit
Different gas prices							
$4.50	12,500	240,000	$4.50	$13,500,000,000	$5,700,000,000		
$3.30	12,500	240,000	$3.30	$9,900,000,000	$2,100,000,000		
$5.80	12,500	240,000	$5.80	$17,400,000,000	$9,600,000,000		
Extreme cases-(low production/low price, high production/high price)							
$3.30	12,500	180,000	$3.30	$7,425,000,000	$1,575,000,000		
$5.80	12,500	300,000	$5.80	$21,750,000,000	$12,000,000,000		

REVENUES WITH THE PETITION AND $0.40/Mcf IN ADDITIONAL COSTS

						Dollar change in profit	Percent change in profit
Different gas prices							
$4.50	12,500	240,000	$4.50	$13,500,000,000	$4,500,000,000	-$1,200,000,000	-21%
$3.30	12,500	240,000	$3.30	$9,900,000,000	$900,000,000	-$1,200,000,000	-57%
$5.80	12,500	240,000	$5.80	$17,400,000,000	$8,400,000,000	-$1,200,000,000	-13%

With the Petition: Least Cost Scenario (assuming no change in the number of wells): At the high end of the range of wellhead prices, $5.80/Mcf, the petition would have the least cost effect to industry, state and local governments. The reasons for this are that the additional costs from the petition would be easier to bear at higher wellhead prices. As in the middle cost scenario with $4.50/Mcf gas, it is assumed that the same number of wells would be drilled at $5.80/Mcf gas with or without the proposed rule. Because the number of wells drilled would stay the same, natural gas production taxes collected, CBM employment, CBM worker income and secondary businesses would not be affected by the petition in this least cost scenario.

From Table 1 under the baseline scenario, 12,500 total wells in Montana multiplied by 240,000 Mcf per well multiplied by $5.80/Mcf equals $17.4 billion in gross revenue and $9.6 billion in profit. Using these same assumptions, the petition would add $0.40/Mcf in additional water disposal costs and result in $17.4 billion in gross revenue, and $8.4 billion in profit. This would result in a loss of $1.2 billion in profit under the petition or a 13% drop in profits. This would result in a drop in corporation tax equal to about $2.7 million per year or $81 million over 30 years.

Varying other assumptions within this least costly scenario, such as assuming 300,000 Mcf or the high range of gas per well, actually results in an increase in profits from baseline, even with the additional water disposal cost. This situation is highly unlikely, and is not considered as a likely scenario. A more plausible situation assumes a low-end additional water disposal cost of only $0.20/Mcf (versus the mid-point additional water

cost assumption of $0.40/Mcf). In this case, profits drop by only $600 million or 6% and corporate taxes drop by only $1.35 million per year or $40.5 million over 30 years. This is the very least costly or best case estimate to industry and society and represents the lower bound of the cost range of the proposed rule.

TABLE 2: Change in Profit Levels from Baseline as a Result of the Rule using the Least Cost Scenario ($5.80/Mcf gas) and Assuming No Change in Number of Wells

HIGH PRICED GAS WITH 12,500 WELLS UNDER INJECTION AND WATER TREATMENT

Gas Price	Tot wells	Mcf/well	Price	Tot Rev	Profit ($2.60 cost)	Change Profit	% change profit
Different well lifetime production amounts							
$5.80	12,500	240,000	$5.80	$17,400,000,000	$8,400,000,000	-$1,200,000,000	-13%
$5.80	12,500	180,000	$5.80	$13,050,000,000	$6,300,000,000	-$3,300,000,000	-34%
$5.80	12,500	300,000	$5.80	$21,750,000,000	$10,500,000,000	$900,000,000	9%
Extreme case/Low cost of injection and water treatment at $0.18/Mcf							
$5.80	12,500	240,000	$5.80	$17,400,000,000	$9,000,000,000	-$600,000,000	-6%

With the Petition: The Most Costly Scenario to industry and society (assuming a 20% drop in the number of wells drilled): So far, it has been assumed that the same number of wells would be drilled, rule or no rule. This is a reasonable assumption at the mid and higher range of assumed PRB wellhead price range, but is likely not a good assumption at the lower end of prices. The lower range of PRB prices is $3.30/Mcf and it is assumed that $3.50/Mcf is a breakeven point for all water disposal techniques. There are a lot of factors that will ultimately affect the number of wells in Montana including lease holdings, geology, natural gas demand, finances, and topography. These factors are well beyond the scope of this analysis, but one factor that can be analyzed here is economic constraints. Using best professional judgment, an assumption is made in this most costly scenario that at a $3.30/Mcf wellhead price (the lowest end of the estimated price range), up to 20% fewer wells (2,500 fewer wells total) would be drilled in Montana due to economic considerations. It is assumed for simplicity that all wells produce the same average amount of gas over their lifetime, so that 20% less total gas would be produced in Montana in this most costly scenario.

In this scenario, not only would industry profits and corporation tax be affected, but also up to 40% of natural gas production tax revenues would be lost because of less wells being drilled (and therefore less gas extracted and less gross revenue) as a result. Up to 20% of CBM-related jobs, personal income and personal income taxes paid under the baseline scenario would also be lost due to the petition. Also, some secondary economic benefits from CBM would be lost under this scenario to area businesses and CBM suppliers. 600 Bcf less gas (20% less gas overall) would be produced in Montana over 30 years.

Under the most costly scenario with 20% fewer wells (10,000 wells drilled total instead of 12,500) and $3.30/Mcf gas, profits decrease by $1.38 billion compared to the

$3.30/Mcf baseline scenario without the petition. Profits over 30 years drop from $2.10 billion to $0.72 billion which translates to a 66% drop in industry profits from baseline.

Varying another assumption within this scenario, if natural gas production per well was at the low end of the range made in the assumptions, 180,000 Mcf per well, then profits decrease by $1.56 billion or 74%, which is a reasonable result that will be used as the very upper bound cost number. Tweaking the last assumption possible and coming up with the absolute most costly scenario, if average additional disposal costs were $0.60/Mcf instead of $0.40/Mcf, then profits drop $1.92 billion or 91%, and perhaps even fewer than 10,000 wells would be developed (possibly a lot fewer). This last case scenario is highly unlikely and is not used in the cost range, but would definitely have a very significant impact on total development if it did occur.

TABLE 3: Change in Profit Levels from Baseline using the Least Cost Scenario ($3.30/Mcf) and Assuming a 20% Reduction in Number of Wells

LOW PRICED GAS WITH A 20% REDUCTION IN WELLS AS A RESULT OF INJECTION AND WATER TREATMENT

Gas Price	Tot wells	Mcf/well	Price		Tot Rev	Profit ($2.60 cost)	Change Profit	% change profit
Different well lifetime production amounts								
	Tot wells	Mcf/well	Price		Tot Rev	Profit	Dollar change in profit	% change in profit
$3.30	10,000	240,000	$3.30		$7,920,000,000	$720,000,000	-$1,380,000,000	-66%
$3.30	10,000	180,000	$3.30		$5,940,000,000	$540,000,000	-$1,560,000,000	-74%
$3.30	10,000	300,000	$3.30		$9,900,000,000	$900,000,000	-$1,200,000,000	-57%
Ave. cost of injection and water treatment is $0.78/Mcf								
$3.30	10,000	180,000	$3.30	$0.78	$5,940,000,000	$180,000,000	-$1,920,000,000	-91%

Using the most costly case for industry, 74% less profits, profits to industry would be $46 million less per year (over 30 years). 6.75% of that is $3.1 million per year less corporate tax to the state general fund or $93 million total over 30 years.

With 20% fewer wells, CBM-related jobs, income and personal income taxes would go down by as much as 20% from the baseline case. Using an employment figure of 645 average annual jobs in Montana, 20% less employment would mean 129 fewer jobs on average per year over 30 years in Montana as a result of the petition. Using $455 million in total personal income over 30 years, 20% less personal income would mean up to $91 million in wages could be lost to workers over 30 years or up to $3 million per year. It is important to note that many of these workers would be from out of state. Using a 3% average state income tax rate, income taxes collected would go down by $2.7 million total over 30 years or $90,000 annually to the state general fund.

The natural gas production tax[4] is far and away the largest money maker for the state and counties from gas production and is based on total gross revenue. Under this most costly scenario of 20% fewer wells, total gross revenue would be significantly affected by requiring injection and/or water treatment. Based on the assumptions made earlier, natural gas production taxes funds in the Montana portion of the PRB would go about 50% to the state general fund and state special revenue funds, and about 50% to counties and their schools. Therefore, all of these entities would be significantly affected.

With $9.9 billion in total gross revenues at $3.30/Mcf gas under the baseline scenario (see Table 1), total tax revenues over 30 years from the 9.26% production tax (under the baseline) are estimated at $917 million with $17.8 million going to the privilege and license tax state special revenue fund for the purpose of paying expenses of the Montana Board of Oil and Gas and $7.9 million going to the oil, gas, and coal natural resource account. Gross revenues from CBM production over 30 years in the most costly scenario are $5.94 billion or $3.96 billion less than baseline for a decrease of 40% in total gross revenues and thus a 40% decrease in natural gas production tax. This results in $367 million less in natural gas production taxes collected over 30 years or $12.2 million less per year. This also results in a loss of $36.3 million in taxes from lower royalties to private landowners (who pay a 15.06% gas production tax on royalties) or $1.2 million per year for a total of $403 million less on natural gas production tax over 30 years. This totals $7.3 million less over 30 years going to the privilege and license tax state special revenue fund for the purpose of paying expenses of the Board of Oil and Gas and $3.2 million less to the oil, gas, and coal natural resource account.

On page 4-119 of the EIS, Big Horn County is predicted to contain 38% of total wells in Montana, Powder River County 37% and Rosebud County 15%. Under MCA 15-36-331, Big Horn shall receive 45.05% of total natural gas taxes collected, Powder River 60.9%, and Rosebud 39.33%. Weighting these counties by the number of wells predicted for each in the EIS, the weighted average of these three percentages is almost exactly 50%. So, 50% of the natural gas production tax would go to the counties and local government in the tri-county area and that 50% number will be assumed for the other counties where the 10% remaining wells would be located. Under MCA 15-36-332, of the total money that goes to counties, Big Horn will put 26.99% towards school districts, Powder River 22.25% and Rosebud 72.97%. Again, the weighted average of those numbers is 32.4% of county money going to schools. Under MCA 15-36-331, the rest of the money, the other 50% in the case of the tri-county area, goes mainly to the state general fund with a small portion going to three other accounts (2 of them state special revenue funds).

So, with $403 million less in natural gas production taxes over 30 years, about $202 million less will go to the counties (mainly Big Horn, Powder River, and Rosebud) with

[4] The format of the following presentation of tax revenues and their distribution is based in part on the format used in Coalbed Methane Development, Powder River Basin of Montana: Economic and Social Impacts of Proposed Development, prepared for the Montana Coalbed Natural Gas Alliance, by Anderson ZurMuehlen and Co., P.C., June 1, 2001.

$65 million of that amount attributed to schools. These numbers translate into $6.7 million per year less to all counties and about $2.2 million per year less to area schools under the worse case scenario. About $182 million less over 30 years or $6.1 million less per year would go to the state general fund. The other $20 million less would be borne by three state accounts.[5] Over 30 years, $8.4 million less would go to the reclamation and development grants special revenue account, $5.9 million less would go to the orphan share account, $5.3 million less would go to the state special revenue fund to be appropriated to the Montana university system for the purposes of the state tax levy as provided in 20-25-423.

Royalty revenue would also be affected under this most costly scenario, because fewer wells would be drilled. The following table summarizes effects on royalties. Under the baseline scenario and most costly condition, using the land ownership assumptions, royalty payments would be:

TABLE 4-Royalties Losses as a Result of the Proposed Rule

ROYALTIES			
	Gross Revenue		**Total Royalty**
Baseline			
Private*	$4,821,300,000	12.50%	$602,662,500
State	$495,000,000	12.50%	$61,875,000
Feds	$4,583,700,000	12.50%	$572,962,500
Most Costly			
Private	$2,892,780,000	12.50%	$361,597,500
State	$297,000,000	12.50%	$37,125,000
Feds	$2,750,220,000	12.50%	$343,777,500
Difference			
Private	-$1,928,520,000		-$241,065,000
State	-$198,000,000		-$24,750,000
Feds	-$1,833,480,000		-$229,185,000
Sub-TOTAL	-$3,960,000,000		-$495,000,000
TOTAL EFFECT (considering after-tax private earnings)			**-$458,695,611**

*This $603 million earned by private landowners is taxed at 15.06%

This $459 million difference in royalty payments would result in about $205 million less over 30 years to private landowners, $25 million less to the permanent school trust fund

[5] Under MCA 15-36-331, The department shall, in accordance with the provisions of 15-1-501, distribute the state portion of oil and natural gas production taxes remaining after the distributions pursuant to subsections (2) and (3) for fiscal years beginning after June 30, 2011, to be distributed as follows: (i) 4.18% to the reclamation and development grants special revenue account established in 90-2-1104, (ii) 2.95% to the orphan share account established in 75-10-743, (iii) 2.65% to the state special revenue fund to be appropriated to the Montana university system for the purposes of the state tax levy as provided in 20-25-423; and (iv) all remaining proceeds to the state general fund. We use the post 2011 numbers for simplicity

(from the loss of royalties on state lands), $115 million less to the federal government, $86 million less to the state general fund and $28.8 million less to county government (half of federal royalties on mineral rights go to the state and under MCA 17-3-240, 25% of the state half goes to counties).

It is also important to note that retrieving less gas (600 Bcf over 30 years in our case) is a cost to all gas users in North America. 20 Bcf per year less gas as a result of the petition represents less than 0.1% of total average annual gas demand in the U.S., so the effect on gas supplies nationwide would be insignificant. There might be some additional costs to state government, specifically the Montana DEQ, from this petition such as changes in monitoring or NPDES permits, but measuring those costs is beyond the scope of this document. Compared to the total water quality protection costs currently borne by the state of Montana, additional costs from the petition are likely to be insignificant and might consist of one additional FTE needed by the Montana DEQ (estimates from the DEQ Water Protection Bureau).

Costs (over 30 years) Under Three Scenarios

The costs borne under all three scenarios are presented in the table below. It is important to note that the loss in royalty payments under the most costly scenario is broken out by those entities that bear the royalty-related costs. The cost to the Montana state general fund includes less money from the gas production tax, less money from state royalties, and less personal income taxes collected. The Counties and Schools category includes less money from the natural gas production tax and less money from the county portion of state royalties. It is important to note that in the most costly scenario, the $93 million loss in corp tax is a part of the $1.56 billion loss in industry profits and that this is $93 million that would not go to the Montana state general fund. So in total, the loss to the Montana state general fund would be $364 million.

TABLE 5-Summary of the Costs of the Rule over 30 Years

Scenario	Industry Profits	Corp Tax*	Jobs (over 30 yrs)	Personal Income	MT Gen Fund	Counties/ Schools	Private land-owners	Fed gov
Middle Cost	$1.20 B	$81 M	None	None	None	None	None	
Least Costly	$0.60 B	$41 M	None	None	None	None	None	
Most Costly^	$1.56 B	$93 M	129	$91 M	$271M	$296M	$205M	$115M

B=Billion dollars, M=Million dollars

* It is important to not double count the costs of less industry profits and corp tax. The loss in corp tax is a part of the loss in profits for all three scenarios, so corp tax loss is a subset of industry profit loss.

^Other costs under the 'most costly scenario include 600 Bcf less natural gas extracted, $25 million less to the permanent school fund trust, $8.4 million less to the reclamation and development grants special revenue account, $5.9 million less to the orphan share account, $5.3 million less to the state special revenue fund to be appropriated to the Montana university system, $7.3 million less to the privilege and license tax state special revenue fund and $3.2 million less to the coal natural resource account.

Benefits of the Petition

Because all beneficial uses of water are protected by federal and state water quality standards, regardless of whether the petition would be in effect or not, the benefit of a traditional non-degradation threshold under the petition would be the margin of safety in water quality that it provides over and above standards. Therefore, this benefit assessment is based upon that margin of safety only.

The benefits from the margin of safety in water quality as a result of requiring injection and/or water treatment of CBM produced waters would go primarily to those who live in proximity to the development itself (mainly in the three counties of Big Horn, Rosebud and Powder River). Compared to those who would bear costs, the beneficiaries of this petition would be a far more narrow and geographically concentrated group and most likely a lower income group than the national and state average. Beneficiaries would include water users who reside in the development area and who live downstream of creeks and rivers and other state waters in the development area. It would also include anyone who gets their water from any local aquifers that might be affected by development.

Specific examples of affected parties include area farmers (especially irrigators), ranchers, and municipalities, commercial businesses and residents with water wells. It also includes organizations like the Tongue River Water Users which has contracts with the state to purchase Tongue River water and which sells and delivers irrigation water to its members. Those living in the area who have water rights (including irrigation groups) and those who own property that could be adversely affected by methane-based water would also benefit. Those who recreate and fish on affected waters such as the Tongue River would also benefit. Finally, those who may not live in the area, but still place a value on those water techniques defined in the petition such as environmentalists, and members of organizations such as the Northern Plains Resource Council, would benefit psychologically if the petition were in effect. Sometimes, economists refer to this last type of non-use beneficial value as "existence value".

The main benefit from the margin of safety that the petition would protect is less risk to valuable natural resources like agricultural soils and aquatic life, and less risk to groundwater resources. It is important to note that the higher risks under current law without the rule would only be at the level of risk when water quality standards are met, since those standards need to be met regardless of the rule. The rule would certainly lower the risk of CBM water violating water quality standards.

Potential socio-economic benefits from the water quality margin of safety as a result of requiring injection and/or water treatment of CBM produced waters include the following: 1) less chance of environmental degradation to natural resources from methane produced waters. Such resources include both agricultural and non-agricultural soils, surface water, groundwater, riparian vegetation, aquatic life, and wildlife, 2) the potential for enhanced recreation in and around affected state waters (especially to anglers), 3) less adverse impacts on farmers and ranchers that use water for irrigation and watering livestock (e.g. agricultural land taken out of production, lower crop output, lost grazing land), 4) to the extent that injection occurs, less chance of residential and municipal wells drying up or losing their water quality which could be a long-term and permanent cost to landowners, 5) the potential for less groundwater drawdown in the development area where injection is done and therefore less 'groundwater opportunity cost' from CBM, 6) less social, community and psychological stress for some residents as a result of knowing that certain water disposal techniques required under the petition are being used, 7) the potential for increased employment and income in the CBM industry as a result of having to build treatment plants, and having to inject waters, 8) less risk of taxpayers and private landowners having to restore land or water damaged by methane-produced water that is not covered by mitigation agreements, 9) the possible beneficial use of advanced treatment CBM water by local landowners, and 10) less chance of decreased property values.

Before discussing the significance and magnitude of these potential benefits, three things are important to note. One is that any benefits that occur would be highly localized to specific areas of CBM development, and some 'margin of safety' surface water related benefits would occur downstream of the development area (with those benefits quickly going to zero as one moves downstream away from the development area). Outside of the CBM development area, there would likely be no physical or economic benefits from the petition. A second important point is that the benefits mentioned above would likely be minimal on a regional basis since water quality standards must be met regardless of the petition. However, certain benefits from the petition could be very significant on a very localized basis to a relatively small number of specific landowners. The rule might even affect the livelihood of a select group of locals. Another important point is that some of the benefits that would occur under the petition could extend far into the future well beyond the lifetime of methane extraction (and thus the time period when the costs of the petition would be felt). This is especially the case for soils that might be spared damage under the petition and groundwater aquifers that might not be drawn down as much under the petition. It is also important to note that the area of concern is sparsely populated, and does not comprise a significant portion of Montana's economy or population, whereas the benefits of Powder River Basin natural gas production may be felt by many people nationwide and yet be insignificant overall.

The benefits under the petition from the margin of safety would likely be very significant for certain landowners in the sparsely populated three-county area, and otherwise insignificant outside the development area. To the extent that injection and water treatment could be used to either replenish aquifers or make usable water, the benefit of the petition could be significant (noting that many residents of the area view the value of

water as “priceless”). Because of these issues, there would be localized significant benefits on a social personal and community level, as people are afraid of losing their quality of life. The closer one lives near development, the greater the effects.

It is unclear how significant the ecological/environmental benefits under the petition would be on a regional level, but likely they would be insignificant due to water quality standards having to be met regardless of the petition. Quantifying these benefits is beyond the scope of this paper, but aquatic life, riparian vegetation, soils and surface water would experience any of those benefits.

The petition would likely have insignificant beneficial effects on farming and ranching on an economic level, since methane companies have to meet water quality and other standards by law as well as agree to a mitigation plan. However, it would have a beneficial effect on CBM-related jobs compared to the baseline due to increased jobs from additional water treatment requirement (which would somewhat offset the 20% job loss in the worst case scenario). The EIS on page 4-118 predicts 10% additional jobs from requiring injection wells only (alternative B) and from requiring diverse water disposal techniques (alternative E) over what would be required without techniques. 851 jobs are estimated as the average annual jobs from Montana CBM for 16,500 CBM wells, so ratcheting that number down proportionately to 12,500 wells gives us an employment figure of 645 average annual jobs. Therefore, it is assumed that up to 65 extra jobs on average per year in Montana could occur from the petition and $45 million in additional personal income over 30 years plus the secondary business that would be generated from that (such as water treatment equipment suppliers). It is important to note that many of those jobs would go to out-of-staters.

Where applicable, business equipment taxes collected from the CBM industry would also likely increase due to additional equipment needed for injection/reinjection and water treatment. Based on two studies (Kuipers, DOE), these business equipment taxes collected might increase as much as 50% per well. However, estimating this tax benefit is beyond the scope of this paper, mainly because some methane companies are organized in such as way that their equipment would not fall under Montana’s Class 8 taxes, but instead would be taxed as a pipeline company (Tax Policy and Research, Montana Dept of Revenue). Depending on how a given coalbed methane company is set up in its corporate structure, it could fall under one class of taxation or the other for its equipment. Any additional business equipment taxes collected would be distributed to state and local governments according to mills.

Additional Considerations

As an element of the Economic Impact Statement, MCA 2-4-405 requires the following four issues to be addressed by the Board:

c) probable costs to the agency and to any other agencies of the implementation and enforcement of the proposed rule,

The Department anticipates that there will be additional workload resulting from the need to review and verify waiver applications to the requirement for reinjection of CBM produced water. Given the level of development assumed in the CBM EIS and the Statement, the DEQ Permitting and Compliance Division anticipates that an additional one FTE would be required for the reviews, costing approximately $90,000 for salary, benefits, and operating expenses. Approximately $100,000 per year would also be needed for contractual support of the reviews that could not be completed by the new FTE.

e) an analysis that determines whether there are less costly or less intrusive methods for achieving the purpose of the proposed rule,

There are other available means to protect water quality than a strict requirement for reinjection or treatment. The numeric water quality standards adopted by the Board will ensure protection of beneficial uses. Designation of EC and SAR as harmful parameters would establish more stringent regulatory threshold below the water quality standard, establishing an additional margin of safety. This action would also result in greater application of treatment technologies, and is thus an alternative means of protecting water quality.

There are other available means to return some CBM produced water to the ground and thereby partially conserve groundwater resources. The use of storage and infiltration ponds as a means of water management would return some produced waters to shallow aquifers and alluvial soils, although the fate and transport of ponded water is not certain, and probably less predictable than that of waters reinjected into specific geologic formations.

f) an analysis of any alternative methods for achieving the purpose of the proposed rule that were seriously considered by the agency and the reasons why they were rejected in favor of the proposed rule,

The Board has not yet deliberated on the provisions of the proposed rules, nor has it selected a preferred course of action by either adopting, rejecting, or amending the proposed rules in response to comments. Selection or rejection of the various provisions of the proposed rules will occur in the late winter/early spring of 2006. By accepting the Petition, however, the Board has preliminarily rejected the status quo as a means of achieving the purpose of the proposed rules, which is to conserve ground water.

g) a determination as to whether the proposed rule represents an efficient allocation of public and private resources,

The proposed requirement for reinjection or treatment is not efficient. Public resources such as Department FTE and budgets are probably better spent on existing permitting tasks, rather than the creation of new activities such as review of reinjection waiver applications. Private resources such as industry investment dollars are best served through the use of a host of water management strategies. Other private parties, such as

landowners and farm/ranch operators, may benefit from the opportunities for even limited beneficial uses, in addition to the sole beneficial use authorized in the Petition

Summary

Costs over 30 years

Under all three cost scenarios:

- $0.60 to $1.56 billion loss in industry profits with an average loss of $1.2 billion (6% to 74% loss in industry profits with an average of 21% profit loss).
- $41 to $93 million of this profit loss would not be collected as corp tax and would thus be lost to the Montana state general fund.

I*n the worst case scenario:*

- 2,500 fewer wells drilled and 600 Bcf less gas produced.
- Up to 129 jobs lost with some of those job losses being felt by out-of-state workers.
- Up to $91 million in personal income lost with some of that being felt by out-of-state workers plus secondary business lost as a result of 20% less wells.
- Up to $271 million less to Montana state general fund (not including the corp tax loss which would bring the total general fund loss to $364 million).
- Up to $296 million less to county and local governments and schools.
- Up to 20% less secondary business impact to suppliers and local area businesses.
- Up to $205 million less in private landowner royalties.
- Up to $115 million less in Federal government royalties.
- Up to $25 million less to the permanent school fund trust.
- Up to $20 million less to three state accounts, two of which are state special revenue accounts.
- Up to $10.5 million less to two state-level natural resource related accounts, one of which is a state special revenue account.

Benefits over 30 years or longer

- Less risk to local area residents of damaged soils, dewatered aquifers and degraded surface water (this benefit could be very long term).
- Less risk of damaging effects to farming, ranching and water wells.
- These effects could be very significant on a local basis in the development area but would likely not be significant beyond that localized area.
- Physical benefits would be confined to development area and downstream users.
- Potentially more water in the ground for future generations.
- ‘Existence value’ benefit to those who would not be directly affected by the petition but who still support it.
- Up to 65 additional jobs and $45 million in personal income from additional water treatment needed and the secondary impacts from that.

References

Associated Press; in the *Billings Gazette*, Sept. 29, 2005, "Wyoming natural gas sells for $4 less than NY prices**".**

BLM et. al.; U.S. Bureau of Land Management, Miles City and Billings Field Offices, Montana DEQ, Montana Board of Oil and Gas Conservation, "Montana Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans", January 2003.

BLM; U.S., Bureau of Land Management, Miles City, Chuck Laakso, personal communication, October 25, 2005.

Bowen, Michael J., "Injection Well and Water Treatment Data", Memorandum, Bowen Coalbed Methane LLC, February 2002.

DOE; U.S. Department of Energy, Office of Fossil Energy and National Energy Technology Laboratory, "Powder River Basin Coalbed Methane Development and Produced Water Management Study", Prepared by Advanced Resources International, Inc., November 2002

EIA, April 2003; U.S. Department of Energy-Energy Information Administration (EIA), "U.S. Natural Gas Markets: Relationship Between Henry Hub Spot Prices and U.S. Wellhead Prices, U.S. EIA Analysis paper", Phillip Budzik, April 2003.

EIA, Jan. 2005; U.S. Department of Energy-Energy Information Administration (EIA). "Annual Energy Outlook, Market Trends-Natural Gas Demand and Supply", January 2005.

EIA, Nov. 2005; U.S. Department of Energy-Energy Information Administration (EIA), "Short Term Energy Outlook", November 8th, 2005.

EIA, Dec. 2005, U.S. Department of Energy-Energy Information Administration (EIA), Annual Energy Outlook 2006 (Early Release): Forecasts and analysis-Natural Gas Prices, December 12th, 2005.

Enerfax Daily website at http://www.enerfaxdaily.com/

Goerold, W. Thomas , Ph.D., Lookout Mountain Analysis, "Powder River Basin Coalbed Methane Financial Model", May 15, 2002.

Horsley & Witten, Inc., "Draft Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs". Prepared for the U.S. EPA, 2001.

Kuipers, James R., "Technology-Based Effluent Limitations for Coal Bed Methane-Produced Wastewater Discharges in the Powder River Basin of Montana and Wyoming", P.E., Kuipers and Associates, August 2004.

MBOGC; Montana Board of Oil and Gas Conservation, On-Line Oil and Gas Information System, 2005.

MCA; Montana Code Annotated 2005.

Montana Department of Revenue, 2002-2004 Biennial Report.

Montana Department of Revenue, personal communication with Van Charlton and with Tax Policy and Research, October and November, 2005.

Morlan, Terry; Northwest Power and Conservation Council, personal communication, 2001.

Northwest Power and Conservation Council. 2005 5th Power Plan, Draft NWE 2006 RPP: Gas Price Forecast, 9/12/05

U.S. Department of the Interior, United States Geological Survey (USGS). *Water Produced with Coal-Bed Methane,* USGS Fact Sheet FS-156-00, November 2000.

Wo et. al.; Wo, Shaochang, David A. Lopez, Jason Whiteman Sr., "Northern Cheyenne Reservation Coal Bed Natural Resource Assessment and Analysis of Produced Water Disposal Options", July 2004. Prepared for U.S. Department of Energy, National Petroleum Technology Office, Native American Initiative

Appendix A: Detailed Discussion of Assumptions Used in this Analysis

- **Total CBM Wells Developed in Montana and Ownership of Mineral Rights:** 12,500 CBM wells will be located in Montana with about 90% of these wells located in three counties: Big Horn, Rosebud, and Powder River. 5,788 of these wells (46.3%) will be located on land where the BLM (federal government) owns the mineral rights, 6,088 (48.7%) wells will be located on land with privately owned mineral rights, and 625 wells (5%) will be located on land with state-controlled mineral rights. These estimates are based upon data found in the EIS.
    - 12,500 total wells is the midpoint in the estimated range of CBM development in Montana given in the EIS (BLM et. al.). The range given in the EIS is 8,500 to 16,400 total wells for the Powder River RMP and Billings RMP (page 4-2).
    - In the EIS, it is estimated that 46.3% of all wells would be BLM wells or wells on federal land. The other 53.7% would be on state and private land (EIS, Minerals Appendix, page MIN-28, Table MIN-1, 'Numerical Prediction for Expanded CBM Development'). Talks with the Miles City BLM (personal communication, Chuck Laakso, October 25, 2005) and data from page 4-121 of the EIS reveal that the remaining 53.7% of mineral rights would break out to about 5% of total wells on land with state mineral rights and 48.7% of total wells drilled on land with private mineral rights. Applying these percentages to the estimated 12,500 total wells in Montana results in 5,788 wells on BLM land, 625 on state lands and 6,088 wells on private land.
    - 90% of the wells will be located in three counties according to p. 4-119 of the EIS.

- **Average Natural Gas Production per Well:** The average CBM well in Montana will produce 0.18-0.30 Bcf of gas during its working life or 180,000-300,000 Mcf per well.
    - The EIS assumes a production rate of 1000 Mcf per month per well as an economic minimum for CBM wells in the Powder River Basin (PRB) to be considered economically successful. The EIS then goes on to suggest that the 'economic minimum' number might be considerably lower in Montana since Montana wells will tend to produce less than those located south in Wyoming (Page 4-10). The EIS also assumes that the average CBM well in the PRB will have a 20-year lifetime (Page 4-8). If this analysis assumes that 1000 Mcf/month is a good <u>average</u> production rate for a working Montana well (as opposed to a good minimum), then 1000 Mcf per month X 12 months X 20 years lifetime = 240,000 Mcf or 0.24 Bcf per average well over its lifetime.
    - In the interest of the sensitivity analysis for petition costs and based upon statements made on page 4-11 of the EIS, one can also use a 15 year lifetime number for a well which results in 180,000 Mcf per well or 0.18 Bcf/well. This gives a good low estimate for average well lifetime gas production. Using a higher Mcf per month production results in 1,250 Mcf X 12 months X 20 years lifetime = 300,000 Mcf or 0.3 Bcf as a good high estimate for average well lifetime.

- An informal talk with industry produced the same range of estimated well production values.
- As a check on the 0.18-0.30 Bcf range, data was obtained from the Montana Board of Oil and Gas 'On-Line Oil and Gas Information System' on active coalbed methane wells in Montana. Fidelity has the only working CBM wells in Montana located in the northern portion of the PRB near Decker. Data was calculated for all working Fidelity wells on the average Mcf per day of gas produced for the average well in each month of its life. Averaged over all wells for all months, the average well after 76 months (6.3 years) has produced about 0.17 Bcf or 173,190 Mcf in total gas total. For the average Fidelity well, average gas production at the 6.3 year mark of operation is below the 1000/Mcf average assumed above. It is about 20-30 Mcf per day or 600-900 per month and will presumably continue to decline over time. Using the 20-year lifespan assumed above and assuming 15 Mcf per day (450 Mcf per month) gas production on average for the rest of a well's lifetime, the estimated total gas production for a 20 year well (173,190 Mcf + (15 X 30days X 12 months X 13.7 years) would be about 247,000 Mcf total gas production for the average Fidelity well. Using a 10 Mcf per day average over the remaining well life would give a total of about 223,000 Mcf per well. Thus, the assumption for average lifetime production per well is very much in line with what the data says so far. It is important to note that most wells in the sample collected were less than 76 months old, so that average gas production in the later months (month 60 and later) had only a few sample points.

- **CBM development in the Montana PRB will take place over the next 20-40 years with an average estimate of 30 years (and an average single well lifetime of 20 years).** The socio-economic analysis in the EIS assumes a staggered well development scenario over 20 years and another 20 years for the eventual abandonment of wells as they end their life (p. 4-118). The 20-40 year development ranges assumed here is based on those numbers.

- **Water to Gas Ratio:** In the Powder River Basin, between 2.0 and 2.75 barrels of CBM-related water are produced on average for every Mcf of gas produced.
  - According to the U.S. Department of the Interior, United States Geological Survey (USGS), *Water Produced with Coal-Bed Methane*, USGS Fact Sheet FS-156-00, November 2000, the Powder River Basin produces 2.75 bbl of water per Mcf of natural gas.
  - According to Horsley & Witten, Inc., "Draft evaluation of impacts to underground sources of drinking water by hydraulic fracturing of coalbed methane reservoirs" (page 2-9), from 1996 to 2000, the water to gas ratio in the Powder River Basin was 2.33 to 3.23 (bbls water to Mcf of gas).
  - As a check on this number, data was obtained from the Montana Board of Oil and Gas, On-Line Oil and Gas Information System, on active coalbed methane wells in Montana. Fidelity has the only working CBM wells in Montana in the northern portion of the PRB. Data was calculated for all

Fidelity wells on the average Mcf per day of gas produced in each month of a well's life. Averaged over all wells, the average well after 76 months (6.3 years) has produced about 173,190 Mcf in total. Averaged over all wells, the average well after 76 months (6.3 years) has produced about 346,800 barrels of water in total. The ratio calculated between barrels of water per Mcf is almost exactly 2.0 from real data, which is below the estimate of 2.75. So 2.75 is used as an upper bound value for this ratio and 2.0 is used as a lower bound for this ratio.

- **Future average wellhead price of natural gas in the United States:** The average wellhead price of natural gas in the U.S. as a whole will average between $4.55/Mcf and $6.31/Mcf in 2005 dollars over the next 20 years from 2006-2025 (EIA, Jan. 2005, Nov. 2005 and Dec. 2005).
    - Clearly, the average U.S. wellhead price will swing out of this range from time to time, so these numbers refer to yearly averages. The average price of natural gas at the Henry Hub in the U.S. is estimated to be $9.00/Mcf in 2006 in the wake of a weak dollar, high oil prices, and damage to Gulf of Mexico production, and is then forecast to come down in the years after that (EIA, Nov. 2005).
    - The second most recent long-term natural gas price forecast made by the U.S. Department of Energy, Energy Information Administration (EIA) in their 'Annual Energy Outlook, 2005' (forecast made in January, 2005) is for an average annual wellhead price of $4.55/Mcf in 2005 dollars from 2006-2025. This forecast is significantly lower than the most recent forecast (released in December of 2005 and discussed below) and can therefore be used as the lower bound for future average U.S. wellhead gas price over the next 20 years.
    - The EIA's 'Short Term Energy Outlook', November 8th, 2005, estimated that the Henry Hub natural gas wellhead price is expected to average about $9.30/Mcf in 2005 and $9.00/Mcf in 2006 which is $3.70 and $4.03 higher respectively than what the long-term forecast made in January, 2005 predicted for those years. The significantly increased estimates are based upon an adjustment to the long-term forecasts due to recent events including high priced oil, a weak dollar and two major hurricanes in the Gulf that have lowered U.S. gas production capability for months to come. As just stated, the difference between the forecasted EIA short-term outlook 2006 wellhead price (made in November 2005) and the estimated long-term 2006 price (made in January 2005) is a staggering $4.03/Mcf. Therefore, $9.00/Mcf is used for average U.S. wellhead gas price in 2006 and then $2.00/Mcf is added to the lower bound forecasted average annual wellhead price (from the second most recent long-term forecast) for the years from 2007-2025. That results in an average wellhead price from 2006-2025 of $6.31 (in 2005 dollars) if we use $9.30 as the 2006 price from the Short Term forecast. $6.31/Mcf is considered an upper bound estimate for average U.S. wellhead price over the next 20 years. A $2 upward adjustment to prices is half of the $4.00/Mcf difference between the two EIA estimates for 2006 natural gas prices—estimates separated by only 10 months.

- The most recent long-term wellhead U.S. natural gas price forecast made by the U.S. Department of Energy, Energy Information Administration (EIA) in their 'Annual Energy Outlook, 2006 (Early Release)' which was released in December of 2006, is for an average annual wellhead price of $5.11/Mcf from 2006-2025. If we use the short term outlook price of $9.00/Mcf for 2006, then this figure becomes $5.22/Mcf over the next 20 years. This is $0.67/Mcf higher than the January 2005 forecast and $1.20/Mcf less than the upper bound estimate of $6.31. A halfway point between the lower bound estimate of $4.55/Mcf and the upper bound estimate of $6.31/Mcf is $5.43/Mcf which is very close to the $5.22/Mcf number from the most recent forecast.
- To further back up the $6.31/Mcf upper bound estimate, Northwestern Energy's revised forecast for its RPP from 9/12/05 for natural gas prices using the Northwest Power and Conservation Council's gas price forecast from its recently published 2005 5th Power Plan and then adjusting using recent AECO futures prices (an Alberta gas hub) and recent EIA prices is $5.62 (in 2005 dollars) for 2006-2025 (Draft NEW 2006 RPP: Gas Price Forecast, 9/12/05.). Terry Morlan of the Northwest Power and Conservation Council believes that wellhead prices of gas received in the Pacific Northwest will tend to be about $.30 to $.50 lower than U.S. wellhead prices over the long run (personal communication, 2001) resulting in a $5.92 to $6.12 forecasted U.S. price, so NWE's estimates are in line with the upper bound estimate of $6.31 assumed here.

- **Future average wellhead price of natural gas in the Powder River Basin.** The average wellhead price of natural gas in the Powder River Basin will average anywhere from $3.30/Mcf to $5.80/Mcf (in 2005 dollars) over the next 20 years with a mid-point price of $4.50/Mcf. This estimated range is calculated by estimating a basin wellhead price differential between the Power River Basin and the Henry Hub of $0.80 to $1.60 per Mcf and a difference between the Henry Hub and U.S. average wellhead price of $0.30/Mcf (EIA 2003, DOE, Associated Press, Enerfax Daily)**.**
  - Per the assumption above, the lower and upper bound of the estimated average U.S. wellhead price of natural gas in the U.S. is $4.55/Mcf to $6.31/Mcf over the next 20 years in 2005 dollars. It is assumed that a $0.80/Mcf to $1.60/Mcf basin differential between the PRB and the Henry Hub will exist in the future. On average, Henry Hub spot prices have been 32 cents per Mcf higher than wellhead prices (U.S. Natural Gas Markets: Relationship Between Henry Hub Spot Prices and U.S. Wellhead Prices, U.S. EIA Analysis paper)[6]. So, a $4.55 to $6.31/Mcf average U.S. wellhead price for 2006-2025, minus the Henry Hub/Wyoming basin price differential of $0.80 to $1.60/Mcf plus the Henry Hub/U.S. wellhead price differential of $0.32/Mcf results in an average wellhead gas price in Wyoming of $3.30 to $5.80/Mcf over the next 20 years in 2005 dollars rounded to the nearest 10 cent interval.
  - The historic average price differential between the Henry Hub and Powder River Basin has been $0.80/Mcf (DOE). The DOE economic model in 'Powder River Basin Coalbed Methane Development and Produced Water

[6] http://www.eia.doe.gov/oiaf/analysispaper/henryhub/index.html

Management Study' assumes that the long-term basin differential between Henry Hub and Rocky Mountain hubs will be a historically-based value of $0.80 per MMBtu in the future (which is about an Mcf), and also assumes a scenario where the basis differential is $1.80 and $1.30 per MMBtu. It is assumed that because gas prices are well above their historic levels that the basin differential will rise as well leading to a $1.60/Mcf differential estimate at the high end of the range.

- To back this up, natural gas producers are currently getting a very high price (relative to historical prices) at Wyoming based hubs for their product as of the writing of this document. In late September, prices at the Wyoming hubs were about $9/Mcf which is 3 to 9 times higher than historical average). Those prices were about $4 less than the record-high prices being fetched on the New York Mercantile Exchange at that time (Associated Press, Billings Gazette, Sept 29, 2005), and a similar differential exist between Wyoming and the Henry Hub. Thus, the basin differential seems to go up somewhat proportionately when gas prices go up. Because future Wyoming wellhead prices are projected to be at least twice their historical average, it seems reasonable to double the historical basin differential average of $0.80/Mcf to $1.60/Mcf as an upper bound for the basin differential and use the historical basis (based on lower historical prices) as a lower bound.

- **Capital and operating costs to CBM operators using surface water disposal (the cheapest water disposal method) will average no more than $2.60/Mcf.** The capital and O& M costs per well in the Powder River Basin (excluding water disposal) will be no more than $1.60/Mcf on average in 2005 dollars. With royalties and taxes added on (assuming a $4.50/Mcf gas wellhead price in the PRB), costs per Mcf are $2.60/Mcf (DOE, Goerold, Kuipers)
  - The DOE study puts capital costs at $88,000 per well which is $4,400 annually over 20 years, O&M at $77,280 over the first 10 years of a well or $7,730 annually, and gas transportation, compression and dehydration at $0.77/Mcf in the Montana portion of the PRB. Assuming the average production per well of 240,000 Mcf, capital, O&M costs and gas compression are $1.44 per Mcf or $1.61/Mcf in 2005 dollars according to the DOE study. Adding royalties in at $4.50 gas adds another 56 cents onto cost plus 42 cents in production tax which results in total costs of $2.59/Mcf. This is the highest cost number found and is used in order to be economically conservative.
  - In the Lookout Mountain Analysis by Tom Goerold (2002), capital costs per well are $0.44/ Mcf, operating costs $0.41/Mcf, surface water disposal $0.01/Mcf, gas gathering at $0.54/Mcf, lease and rental $0.10/mcf, royalties paid out are $0.52/Mcf and all taxes (in Wyoming) at $0.55/Mcf. The total cost from this study is $2.03/Mcf which is $2.25/Mcf in 2005 dollars.
  - In an anecdotal discussion of economics, Kuipers in his paper mentions a $1.50/Mcf cost per well which likely does not take into account royalties and taxes.

- **CBM water treatment under current law:** Under current law, without the proposed rule, CBM operators would use advanced treatment (such as reverse osmosis) on 20% of discharged water. The other 80% would be disposed of in the least costly way possible to meet existing water quality standards, such as into percolating ponds or directly into state waters.

- **CBM water treatment under the proposed rule in the petition:** Under the conditions laid out by the petition, 20% of CBM-produced water from wells in Montana would be injected or re-injected into the ground as a water disposal technique. Geological and technical constraints would prevent any more than 20% of water from being injected (BLM et. al.). Because the only other acceptable disposal techniques under the petition would involve advanced water treatment (e.g. reverse osmosis, ion exchange), the remaining 80% of water disposed under the petition would use advanced water treatment before being discharged above ground.
    - Because Montana has no experience in well water injection, this estimate was made based on the EIS which assumes in its Alternative E (CBM water being managed in a much broader fashion than simply surface disposal) that 20% of all produced CBM water will be managed by shallow injection (page 4-77 and 4-78 including Table 4-35) and the other 80% by other techniques.

- **Cost of injection:** Using the upper range of available studies, it would cost CBM operators $0.80/Mcf more on average to use injection/reinjection of methane-produced water than to use the cheapest method of surface disposal into nearby waterways (Goerold, Kuipers, Bowen, Wo et. al., DOE).
    - Based on numerous studies, surface disposal costs operators no more than $0.05 per Mcf and often rounds down to zero cents per Mcf (Goerold: Lookout Mountain Analysis, Kuipers "Technology Based Effluent Limitations for Coalbed Methane Produced Wastewater Discharges in the PRB of Wyoming, page 16).
    - Past studies have estimated a range of costs of $0.23 to $0.72 per Mcf for all types of injection (shallow and deep). In 2005 dollars, this range is $0.25 to $0.81 per Mcf. The high end estimate is used in order to be economically conservative. This compares to surface discharge, which is likely no more than 5 cents per Mcf, and could be rounded down to zero cents in some cases.
    - In the "Powder River Basin Coalbed Methane Financial Model" by W. Thomas Goerold, Ph.D., Lookout Mountain Analysis, May 15, 2002, in the Eastern Region of the study, the breakeven Henry Hub wellhead gas price for deep injection is calculated at $2.98/Mcf whereas the breakeven point for surface disposal is $2.25/Mcf for a difference of $0.72/Mcf. In the Northern Region, the breakeven gas price for surface disposal in the Northern case is $2.47 and for deep injection is $3.05 or a difference of $0.58 per Mcf. This produces a range from this study of 55-72 cents per Mcf cost difference between the two water disposal methods, which is $0.62 to $0.81 in 2005 dollars. This highest number from all studies looked at is used in order to be economically conservative.

- Assuming 200,000 Mcf gas production over lifetime of an average well, costs are $0.30 to $0.56 cents per Mcf for deep injection according to the "Northern Cheyenne Reservation Coal Bed Natural Resource Assessment and Analysis of Produced Water Disposal Options", Shaochang Wo, David A. Lopez, Jason Whiteman Sr., July 2004). Put in 2005 dollars, those numbers are $0.32 to $0.59 per Mcf.
- In the DOE study (2002) page 5-4, assuming 240,000 Mcf gas production per well, shallow reinjection costs about $0.23 per Mcf and deep re-injection with reverse osmosis is about $0.53/Mcf. In 2005 dollars, these numbers are $0.25 and $0.58 respectively.
- Michael J. Bowen: Total water treatment and injection costs would range from $0.85 to $0.90 per Mcf in year 1 to $0.10 in year 15.
- In Kuipers "Technology Based Effluent Limitations for Coalbed Methane Produced Wastewater Discharges in the PRB of Wyoming", in Table 3.4 of Page 21 which list the costs of injection/reinjection, the median operating cost per barrel of water of all the studies looked at in the Powder River Basin including Goerold, Boysen, DOE, Argonne National Labs, Coalbed Methane Producers is $0.27 per barrel or $0.73 per Mcf (using the 2.75 ratio assumption) for reinjection which would be just under 80 cents in 2005 dollars.

- **Cost of advanced water treatment:** Using the upper range of available studies, it would cost CBM operators $0.40/Mcf more on average to use advanced water treatment (e.g. reverse osmosis, ion exchange) to treat water than it would cost to use surface disposal. For simplicity, it is assumed that all water treatment technologies would average $0.40/Mcf in cost (Kuipers, Bowen).
  - In Kuipers "Technology Based Effluent Limitations for Coalbed Methane Produced Wastewater Discharges in the PRB of Wyoming", 2004 (page 22), this paper looks at various studies (including studies by Coalbed Methane Producers, Lang and ALL) that estimate reverse osmosis operating costs to range from $0.09 to $0.17 per bbl of water with an average value of $0.13 per bbl. Calculated with capital costs included, for reverse osmosis with commercial brine disposal and surface discharge, the net present value cost is 19 cents per barrel of water. The study assumes one barrel or water per 1 Mcf, but we assume 2.75 barrels of water to each Mcf. Splitting the difference, at 2 barrels of water per 1 Mcf of gas (our lower bound), results in 38 cents per Mcf or 40 cents in 2005 dollars (page 35). This highest cost number from all studies looked at is used in order to be economically conservative.
  - From Michael J. Bowen, 'Injection well and Water Treatment data', Memorandum, Bowen Coalbed Methane LLC, feb. 5, 2002. In Hanging Woman Basin, near the Montana state line, the estimated costs of a treatment plant (reverse osmosis) would range from $0.77/Mcf in year 1 to $0.08/Mcf in year 15. If we take these numbers and average them out over 15 years and barrels of water per year, we get an average cost for reverse osmosis of 23 cents per Mcf or 25 cents per Mcf in 2005 dollars.

- **Average addition cost of water management under the petition as compared to current law:** The average cost for a CBM operator under the petition would be $0.40/Mcf greater than it would be using surface water disposal. This is arrived at by summing $0.80 of additional cost for injection multiplied by 20% (16 cents/Mcf) and $0.40 additional cost for advanced treatment multiplied by 80% (32 cents/Mcf). Summing these two numbers results in a $0.48/Mcf average water management cost for operators under the petition. Under current law and assuming a zero cost for direct surface water discharge, the average water management cost for a CBM operator would be about $0.08/Mcf, which is arrived at by multiplying $0.40/Mcf for advanced treatment times 20% (8 cents/Mcf). The difference between these two costs is $0.40/Mcf. For sensitivity analysis purposes, this additional cost number could range from $0.20 to $0.60 per Mcf.

- **A Power River Basin wellhead gas price of $3.50/Mcf is the operator breakeven point for the average well for all water disposal methods. Therefore, the number of wells drilled in the Montana portion of the Powder River Basin would be the same under the petition as it would be without the petition, except under the most adverse conditions to industry (such as $3.30/Mcf gas and low well production). Under the most adverse conditions to industry, the petition would result in up to 20% fewer wells.**
    - Using the assumptions so far of $2.60 Mcf in total operator costs (including taxes and royalties), plus $0.80/Mcf in deep injection costs (the most expensive water management technology which would only be used on 20% of water), plus a 10 cent-per-Mcf contingency, results in $3.50/Mcf as a breakeven point. This is an economically conservative number for the average well (upper bound cost). The average cost per well is likely lower than this number.
    - In the DOE study (page 6-7), it is estimated that at $2.50/Mcf and above, $2.75 in 2005 dollars, all projects in their study that are economically viable in their baseline remain economically viable regardless of produced water management method analyzed. This assumption is also true under the other TDS limits and is consistent across all the major Powder River Basin regions. This estimate is 75 cents less than what is used in this analysis.
    - In the Lookout Mountain Analysis Report (2001), the results for the Northern Production area of the PRB is that all water disposal methods would result in profits for the methane producers at a Henry Hub gas price of $3.05/Mcf or $3.42/Mcf in 2005 dollars.

- **Coalbed methane is natural gas and is taxed as natural gas** (Van Charlton. Montana Dept of Revenue).

- **Natural gas production tax:** Under MCA 15-36-304, the natural gas production tax is 9.26% on gross revenues. Most of that tax, the 9.00% portion, goes to the state general fund, two special revenue accounts and the counties within which development takes place. A 0.18% portion goes to the privilege and license tax which

is a state special revenue fund for the purpose of paying expenses of the Montana Board of Oil and Gas Conservation. The remaining 0.08% goes to the oil, gas, and coal natural resource account. In the first year of a CBM well, the gas production tax is only 0.76%, but for simplicity's sake and due to the fact that first year gas production of a typical CBM well is negligible, a 9.26% rate is assumed for the lifetime of the well.

- **Royalties:** The royalty rate for the mineral right holder is 12.5%, which is the standard royalty rate. Other royalty rates exist, but for simplicity the 12.5% rate is assumed for all wells. The tax on royalties held by private landowners is 15.06%. Royalties that go to federal and state mineral right owners are not taxed (Montana Dept. of Revenue, personal communication)**.**

- **Tax distribution:** Under MCA 15-36-331, Big Horn County shall receive 45.05% of total natural gas production taxes collected from wells located in within its borders, Powder River County 60.9%, and Rosebud County 39.33%. Weighting these averages by the estimated number of wells in each county, about 50% of total natural gas production taxes collected in this tri-county area would go to the counties. Under MCA 15-36-332, of the total money that goes to counties, Big Horn will put 26.99% towards school districts, Powder River 22.25% and Rosebud 72.97%. Under MCA 15-36-331, the rest of the natural gas production tax money, the other 50%, goes mainly to the state general fund with a small portion going to four other accounts (2 of them state special revenue funds).

- **Royalties on state land:** All of royalties earned on land with State mineral rights goes to the permanent school trust fund. Half of the royalties earned on land with federal mineral rights goes to the state of Montana. Under MCA 17-3-240, money paid to the state from federal royalties must be deposited in the state general fund. In fiscal year 2005 and each succeeding fiscal year, 25% of all of this money received by the states is dedicated to local governments.

- **Montana's corporation license tax:** The state corp tax is a franchise tax levied on corporations, including banks and savings and loan associations, for "…the privilege of carrying on business in this state." The tax is levied at the rate of 6.75% on net income (or net revenues) earned in Montana. 100% of corporate license taxes are deposited into the state general fund. (Montana Department of Revenue, 2002-2004 Biennial Report).

- **Business equipment tax collections would possibly increase by as much as 50% under the petition, but are beyond the scope of this analysis.**
    - From the Kuipers report, on a well field basis (10 wells), the estimated total capital cost for injection and reinjection is $532,536 (page 34) or $53,536 per well. On a well field basis, the estimated total capital cost for Alternative 5a, Reverse Osmosis is $450,579 or $45,057 per well (page 35).
    - DOE (2002), page 4-2, capital cost per well in PRB is $88,000 on average. Capital cost for shallow re-injection is $15,150 per well, active treatment with

trucking is $19,600 per well and active treatment with deep re-injection is $35,200 per well (or about 40% of the $88,000). Tangible well drilling and well completion costs for a PRB well are $15,600 for an 850 foot well (p. 4-6). The tangible costs for water gathering and subsurface piping for one well would be $2,100 rounded up (page 4-8). Capital costs of electric power per well are estimated at $8,450. The cost of gas gathering is estimated at $7,820 per well. The total tangible capital costs for one CBM well would be $33,970 not including water disposal.

- Lookout Mountain analysis estimates a capital cost per well of $0.44 per Mcf and a capital cost per well of deep injection of $0.29 per Mcf.